WHAT IS CLAIMED IS:

1. A process for making a heat treated ground ceramic cutting insert comprising the steps of:

providing an uncoated ground ceramic cutting insert having at least a portion thereof being ground; and

heat treating the uncoated ground ceramic cutting insert so as to form the heat treated ground ceramic cutting insert.

2. The process according to claim 1 wherein the heat treatment occurs in an atmosphere comprising one or more of nitrogen and argon and carbon monoxide; the heat treatment occurs at a pressure ranging from sub-atmospheric to about 30,000 psi; the heat treatment occurs at a temperature ranging between about 1300 degrees Centigrade and about 2200 degrees Centigrade; and the heat treatment occurs for a time between about fifteen minutes and about six hours.

3. The process according to claim 1 wherein the heat treatment occurs in a nitrogen atmosphere at a pressure of one atmosphere and at a temperature of between about 1815 degrees Centigrade and 1860 degrees Centigrade for a duration of between about 130 minutes and about 270 minutes.

4. The process according to claim 1 wherein the heat treatment occurs in an argon atmosphere at a pressure of about one atmosphere and at a temperature of about 1650 degrees Centigrade for a duration of about 60 minutes.

5. The process according to claim 1 further including the step of coating the heat treated ground ceramic cutting insert.

6. The process according to claim 5 wherein the coating is selected from one or more compounds of the group consisting of alumina, titanium nitride, titanium carbonitride, titanium carbide and titanium aluminum nitride.

7. The process according to claim 1 further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

sintering the green ceramic cutting insert compact so as to form a sintered unground ceramic cutting insert compact;

hot isostatically pressing the sintered unground ceramic cutting insert compact so as to form an uncoated unground ceramic cutting insert blank; and

grinding at least a portion of the uncoated unground ceramic cutting insert blank so as to form the uncoated ground ceramic cutting insert.

8. The process according to claim 7 wherein after the hot isostatically pressing step, the uncoated unground ceramic cutting insert is subjected to an additional sintering step.

9. The process according to claim 1 further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

sintering the green ceramic cutting insert compact so as to form a sintered unground ceramic cutting insert compact; and

grinding at least a portion of the sintered unground ceramic cutting insert compact so as to form the uncoated ground ceramic cutting insert.

10. The process according to claim 9 wherein the powder mixture comprises between about 60 weight

percent and about 98 weight percent silicon nitride, up to about 25 weight percent aluminum nitride, up to about 25 weight percent alumina, up to about 2 weight percent magnesia, and up to about 7 weight percent yttria.

11. The process according to claim 7 wherein the powder mixture comprises about 98 weight percent silicon nitride, about 1 weight percent magnesia and about 1 weight percent yttria.

12. The process according to claim 9 wherein the powder mixture comprises about 85.4 weight percent silicon nitride, about 6.2 weight percent aluminum nitride, about 3.7 weight percent alumina, and about 4.7 weight percent yttria.

13. The process according to claim 9 wherein the powder mixture comprises about 63.3 weight percent silicon nitride, about 9.3 weight percent aluminum nitride, about 22.7 weight percent alumina, and about 4.7 weight percent yttria.

14. The process according to claim 7 wherein the powder mixture comprises about 91.6 weight percent silicon nitride, about 1.6 weight percent aluminum nitride, about 1.3 weight percent alumina, and about 5.5 weight percent yttria.

15. The process according to claim 7 wherein the powder mixture is silicon nitride-based, and prior to the sintering step, the green ceramic cutting insert compact is in contact with a setting powder; and the setting powder includes one or more of the following and/or their reaction products: the oxides of aluminum, hafnium, zirconium, yttrium, magnesium, calcium and the metals of the lanthanide series of the elements; and nitrides and/or carbides of silicon,

titanium, hafnium, aluminum, zirconium, boron, niobium and carbon.

16. The process according to claim 7 wherein the powder mixture further including up to thirty volume percent of at least one component selected from the group of hafnia, zirconia, and the nitrides, carbides and/or carbonitrides of titanium, silicon, hafnium, and zirconium and their mixtures.

17. The process according to claim 1 further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

uniaxially hot pressing the green ceramic cutting insert compact so as to form a hot pressed unground ceramic cutting insert compact; and

grinding at least a portion of the hot pressed unground ceramic cutting insert compact so as to form the uncoated ground ceramic cutting insert.

18. The process according to claim 17 wherein the powder mixture comprises alumina and silicon carbide whiskers.

19. The process according to claim 18 wherein the powder mixture further includes zirconia.

20. The process according to claim 18 wherein the powder mixture further includes titanium carbonitride.

21. The process according to claim 20 wherein the powder mixture comprises about 34.4 weight percent alumina, about 19.1 weight percent silicon carbide whiskers, about 0.3 weight percent yttria, and the balance titanium carbonitride.

22. The process according to claim 21 wherein the titanium carbonitride has the formula TiC_xN_y, and equals about 0.5 and y equals about 0.5.

23. The process according to claim 9 wherein the powder mixture comprises about 14.2 weight percent zirconia; about 2.3 weight percent $MgAl_2O_4$; about 1.2 weight percent silicon carbide whiskers; about 0.14 silicon dioxide; about 0.02 calcium oxide; and the balance alumina.

24. The process according to claim 1 further including the step of grinding at least a portion of the uncoated heat treated ground cutting insert.

25. A heat treated ground ceramic cutting insert produced by the process comprising the steps of:

providing an uncoated ground ceramic cutting insert having at least a portion thereof being ground; and

heat treating the ground ceramic cutting insert so as to form the heat treated ground ceramic cutting insert.

26. The cutting insert according to claim 25 wherein the process further includes the step of coating the heat treated ground ceramic cutting insert.

27. The cutting insert according to claim 25 wherein the process further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

sintering the green ceramic cutting insert compact so as to form a sintered unground ceramic cutting insert compact;

hot isostatically pressing the sintered unground ceramic cutting insert compact so as to form an uncoated unground ceramic cutting insert blank; and

grinding at least a portion of the uncoated unground ceramic cutting insert blank so as to form the uncoated ground ceramic cutting insert.

28. The cutting insert according to claim 25 wherein the process further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

sintering the green ceramic cutting insert compact so as to form a sintered unground ceramic cutting insert compact; and

grinding at least a portion of the uncoated unground ceramic cutting insert blank so as to form the uncoated ground ceramic cutting insert.

29. The process according to claim 27 wherein the powder mixture comprises about 14.2 weight percent zirconia; about 2.3 weight percent $MgAl_2O_4$; about 1.2 weight percent silicon carbide whiskers; about 0.14 silicon dioxide; about 0.02 calcium oxide; and the balance alumina.

30. The cutting insert according to claim 25 wherein the powder mixture comprises between about 60 weight percent and about 98 weight percent silicon nitride, up to about 25 weight percent aluminum nitride, up to about 25 weight percent alumina, up to about 2 weight percent magnesia, and up to about 7 weight percent yttria.

31. The cutting insert according to claim 25 wherein the process further including the steps of:

forming a green ceramic cutting insert compact from a powder mixture;

uniaxially hot pressing the green ceramic cutting insert compact so as to form a hot pressed unground ceramic cutting insert compact; and

grinding at least a portion of the hot pressed unground ceramic cutting insert compact so as to form the uncoated ground ceramic cutting insert.

32. The process according to claim 31 wherein the powder mixture comprises alumina and silicon carbide whiskers.

33. The process according to claim 32 wherein the powder mixture further includes zirconia.

34. The process according to claim 32 wherein the powder mixture further includes titanium carbonitride.

35. A heat treated ground ceramic cutting insert formed in the presence of a reaction source, the cutting insert comprising:

a substrate having a surface which defines a rake face and a flank face wherein there is a cutting edge at the intersection of the rake face and the flank face;

the substrate presenting a microstructure wherein there being a surface region extending inwardly from the surface of the substrate, and there being a bulk region inwardly of the surface region;

the bulk region having a bulk composition; and

the surface region having a surface composition resulting from a reaction with the reaction source wherein the surface composition being different from the composition of the bulk region.

36. The cutting insert of claim 35 wherein the surface composition having a content of a selected element that is higher than the content of selected element in the bulk composition.

37. The cutting insert of claim 35 wherein the surface composition having a content of a selected element that is lower than the content of selected element in the bulk composition.

38. The cutting insert of claim 35 wherein the surface region having a first microstructure and a first hardness; and the bulk region having a second microstructure and a second hardness; the first microstructure of the surface region being different from the second microstructure of the bulk region; and the first hardness of the surface region being greater than the second hardness of the bulk region.

39. The cutting insert according to claim 35 further including a coating on the rake face and the flank face.

40. The cutting insert according to claim 35 wherein the surface region having a first fracture resistance and the bulk region having a second fracture resistance; and the first fracture resistance of the surface region being greater than the second fracture resistance of the bulk region.

41. The cutting insert according to claim 35 wherein the surface region having a first wear resistance and the bulk region having a second wear resistance; and the first wear resistance of the surface region being greater than the second wear resistance of the bulk region.

42. The cutting insert according to claim 35 wherein the substrate being a silicon nitride-based composition, and the first microstructure of the surface region comprising β-silicon nitride phase and $Y_2Si_3O_3N_4$ phase, and the second microstructure of the

bulk region consists essentially of β-silicon nitride and an intergranular phase.

43. The cutting insert according to claim 35 wherein the surface region has an aluminum content higher than the aluminum content of the bulk region.

44. The cutting insert according to claim 35 wherein the substrate being a Sialon-based composition; and the first microstructure of the surface region comprises β'-Sialon, α'-Sialon and N-YAM; and the second microstructure of the bulk region comprises a mixture of α'-SiAlON and β'-SiAlON.

45. The cutting insert according to claim 35 wherein the substrate being a Sialon-based composition; and the first microstructure of the surface region comprises β'-Sialon and 15R phase; and the second microstructure of the bulk region consists essentially of β'-SiAlON.

46. The cutting insert according to claim 35 wherein the substrate being a Sialon-based composition; and the first microstructure of the surface region comprises β'-Sialon and N-Melilite; and the second microstructure of the bulk region consists essentially of β'-SiAlON, B-phase and N-α-Wollastonite.

47. The cutting insert according to claim 35 wherein the substrate including alumina, zirconia and silicon carbide whiskers; and the first microstructure of the surface region comprises alumina, tetragonal zirconia, monoclinic zirconia, silicon carbide, $MgAl_2O_4$, and ZrO/ZrC; and the second microstructure of the bulk region comprises alumina, monoclinic zirconia, tetragonal zirconia and ZrO.

48. A process for making a heat treated ground ceramic article of manufacture comprising the steps of:

providing an uncoated ground ceramic compact having at least a portion thereof being ground; and

heat treating the uncoated ground ceramic compact so as to form the heat treated ground ceramic article of manufacture.

49. The process according to claim 48 further including the step of coating the uncoated heat treated ground article of manufacture.

~~50~~. A heat treated ground ceramic cutting insert formed in the presence of a reaction source, the cutting insert comprising:

a substrate having a surface which defines a rake face and a flank face wherein there is a cutting edge at the intersection of the rake face and the flank face;

the substrate presenting a microstructure wherein there being a surface region extending inwardly from the surface of the substrate, and there being a bulk region inwardly of the surface region;

the bulk region having a bulk microstructure comprising beta silicon nitride phase; and

the surface region having a surface microstructure resulting from a reaction with the reaction source wherein the surface microstructure comprising β′ sialon phase, or α′ plus β′ sialon phase.

~~51~~. A heat treated ground ceramic cutting insert formed in the presence of a reaction source, the cutting insert comprising:

a substrate having a surface which defines a rake face and a flank face wherein there is a cutting edge at the intersection of the rake face and the flank face;

the substrate presenting a microstructure wherein there being a surface region extending inwardly from the surface of the substrate, and there being a bulk region inwardly of the surface region;

the bulk region having a bulk microstructure consisting essentially of β′ sialon phase and intergranular phase; and

the surface region having a surface microstructure resulting from a reaction with the reaction source wherein the surface microstructure comprising β′ sialon and α′ sialon.

52. The process according to claim 1 wherein the uncoated ground cutting insert during the heat treating is in contact with a setting powder; and the setting powder includes one or more of the following and/or their reaction products: the oxides of aluminum, hafnium, zirconium, yttrium, magnesia, calcium, and the metals of the lanthanide series of the periodic table; and nitrides and/or carbides of silicon, titanium, hafnium, aluminum, zirconium, boron, niobium and carbon; and

wherein during said heat treating said uncoated ground cutting insert reacting with said setting powder wherein the composition of surface of the uncoated ground ceramic cutting insert has been modified.

53. A heat treated ground ceramic cutting insert formed in the presence of a reaction source, the cutting insert comprising:

a substrate having a surface which defines a rake face and a flank face wherein there is a cutting edge at the intersection of the rake face and flank face;

the substrate presenting a microstructure wherein there being a surface region extending inwardly from the surface of the substrate and there being a bulk region inwardly of the surface region; and

wherein the surface region comprises one or more phases formed during heating in the presence of the reaction source, and wherein the one or more phases include a reaction product of the reaction source, and the reaction source including one or more of the following or their reaction products: the oxides of aluminum, hafnium, zirconium, yttrium, magnesium, calcium and the metals of the lanthanide series of the periodic table; and nitrides and/or carbides of silicon, titanium, hafnium, aluminum, zirconium, boron, niobium and carbon.

54. The heat treated ground cutting inserts of claim 53 wherein said phase includes titanium nitride.